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## The Genus *Tulostoma* Pers.: Pers. (*Gasteromycetes*) in Turkey

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**Abstract :** Three species of *Tulostoma* are recorded for the Turkish mycoflora, namely, *T. pluriosteum* Long & Ahmad, *T. squamosum* Gmelin: Pers. and *T. wightii* Berk. *Tulostoma brumale* Pers.: Pers. is already known from this country. Photomicrographs of the spores under SEM are also given.

**Key Words :** *Tulostoma*, Taxonomy, Turkey

### *Tulostoma* Pers.: Pers. Genusunun (*Gasteromycetes*) Türkiye'deki Durumu

**Özet :** Türkiye Mantar Florası için *T. pluriosteum* Long & Ahmad, *T. squamosum* Gmelin: Pers. ve *T. wightii* Berk isimli üç *Tulostoma* türü kaydedilmiştir. *Tulostoma brumale* Pers.: Pers. daha önceden bu ülkede tanınmaktadır. Sporların SEM altındaki görüntüleri de verilmiştir.

**Anahtar Sözcükler :** *Tulostoma*, Taksonomi, Türkiye

### Introduction

The genus *Tulostoma* Pers.: Pers. (from the Greek *tulos*=knob, and *stoma*=mouth) is a member of a large group of fungi, the *Gasteromycetes*, which at maturity produce a powdery mass of spores within a spore sac, and are known commonly as puffballs. It is characterised by having a more or less globose spore sac upon a stem that rapidly expands shortly after the onset of spore maturation. The gleba is completely surrounded by the peridial "tissues" until maturity, and dispersal of spores takes place by means of an apical aperture, the mouth or stoma. This may be perfectly tubular, circular or elliptic, or fibrillose or fimbriate, and in some cases may even simply be a torn aperture. Ripening of the spore sac takes place hypogenously; when the expanding stipe exposes it above the soil surface, the gleba is already a powdery mass (1).

The world species of *Tulostoma* have for the last 25 years been studied by Wright. "The Genus *Tulostoma*: A World Monograph" (1987) paved the way for future studies. Some species of *Tulostoma* have been recorded from Israel (2). In Turkey, the 1st member of the genus, *Tulostoma fimbriatum* Fr., was recorded by Gücin & Öner (3) in Salihli, and the 2nd one, *Tulostoma brumale* Pers.: Pers., by Sesli (4) in Trabzon (Fig. 1). This is a common European species, and the collection conforms with the usual interpretation. After Gücin's study, *Tulostoma fimbriatum* was recorded again by Afyon (5) in Konya. The presence of 5 species of *Tulostoma* in Turkey (Fig. 2) is extremely interesting since they grow in very particular habitats.

*Tulostoma* is a very attractive genus of *Gasteromycetes* since its more than 100 species, distributed throughout most of the world, present

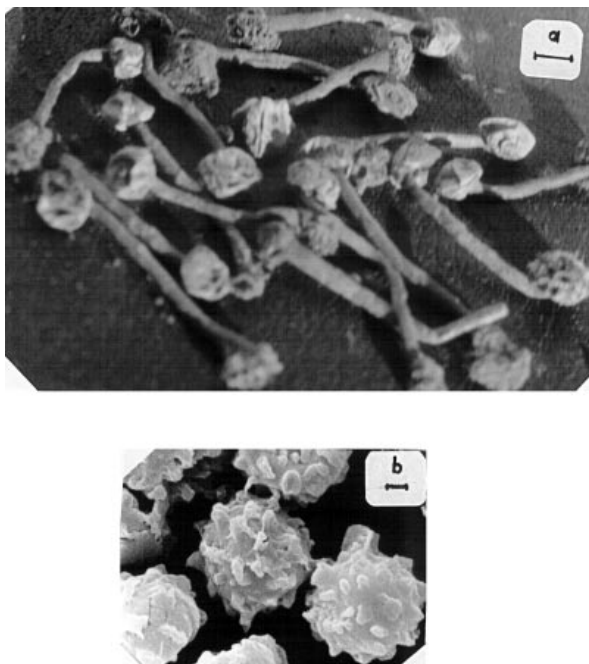


Figure 1. *Tulostoma brumale*: a. Fruit bodies: Bar: 5 mm, b. Photomicrographs of spores under SEM: Bar: 1 µm.

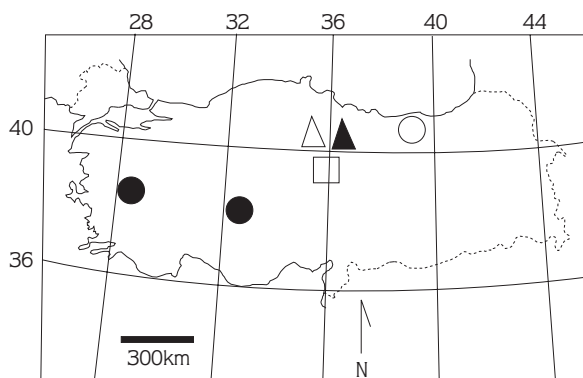


Figure 2. Distribution of species of *Tulostoma* in Turkey (○ *T. brumale*, ● *T. fimbriatum*, △ *T. squamosum*, ▲ *T. plurios-teum*, □ *T. wightii*)

considerable taxonomic complexity (6). These fungi prefer xeric areas with scarce rainfall and with nutritionally poor soils. These include temperate regions, such as the Mediterranean, subarid regions, and deserts.

During field studies in Tokat and environs, of Turkey, undertaken during the period 1997-1998, 4 *Tulostoma* species were found. Three of them are new records for the Turkish mycoflora.

The aim of this study is to make a contribution to the Turkish myco-biota by introducing the genus *Tulostoma*.

### Materials and Methods

SEM photomicrographs were obtained with a Phillips instrument belonging to CITEFA SEM Service (Argentina). Spores were mounted in 70% ethyl alcohol and dispersed with a fine needle on either a copper or an aluminium stub, and air dried. The stubs were coated with a layer of gold-palladium or gold alone, and processed in a standard sputter coater. Observations were made at either 15 or 25 kV, according to the conditions of the sample. For the study of the exoperidial features, a small portion was dissected from a specimen and examined under dissecting microscope (1,7).

All collections cited were deposited in Ertuğrul Sesli's herbarium, Fatih Faculty of Education, Karadeniz Technical University.

### Results

Gasteromycetes

Tulostomatales

Tulostomataceae

*Tulostoma squamosum* Gmelin: Pers. (Syn. *Tulostoma mussooriense* P. Hennings), Fung.: 139, 1801.

**Macroscopic features:** Spore sac up to 10 mm diam. (Fig. 3 a). Exoperidium membranous to verrucose. Endoperidium dark dirty reddish brown. Mouth circular, with a dark peristome. Stem straw-coloured, 15x2 mm, almost smooth.

**Microscopic features:** Spores yellowish, unequally warty, globose to ellipsoid 4-6 µm diam; under SEM they appear as having highly anastomosed elevated crests which confers on them a very peculiar aspect, somewhat cauliflower-like (Fig. 3 b). Capillitium much branched and septate, broadened at the brown septa; thick-walled, lumen visible to lacunar, walls up to 4 µm thick; 5-15 µm diam.

**Habitat:** Calcareous soil, gregarious, Sept., 1998.

**Distribution:** India; Georgia; Turkey: Tokat, SES 1002.

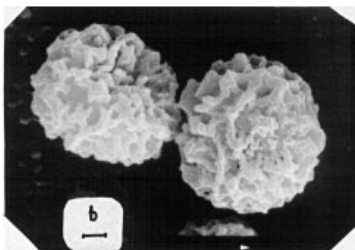


Figure 3. *Tulostoma squamosum*: a. Fruit bodies: Bar: 5 mm, b. Photomicrographs of spores under SEM, Bar: 1  $\mu$ m.

**Discussion:** This collection is similar to *T. mussooriense* P. Henn. which thus broadens the known distribution of this species. However, Moreno et al. (8) have shown that this species is identical to *T. squamosum* from Europe, of which it may be a mere variant. The name *mussooriense* refers to the original collecting ground, the Mussoorie Hills in N. India. It is a distinct and remarkable species, that can easily be distinguished from all the rest, particularly from those with verrucose exoperidia, by the sum of its macroscopic features and its spore ornamentation (1).

*Tulostoma pluriosteum* Long & Ahmad, Farlowia 3 : 235, 1947.

**Macroscopic features:** Spore sac up to 15 mm diam. (Fig. 4 a). Exoperidium apparently thinly membranous. Endoperidium greyish ochre. Mouth circular, sometimes more than 1 in the same spore sac. Stem up to 50x5 mm, blackish brown, subwoody, striate, equal.

**Microscopic features:** Spores yellowish, spiny subglobose to ellipsoid under LM, 5-6  $\mu$ m diam.; under SEM they appear as densely packed, large, conical spines, some rounded at the apex (Fig. 4 b). Capillitium branched, hyaline to yellowish, thick-walled (up to 3  $\mu$ m), unevenly thickened, multiseptate, septa deep brown;

hyphae widened at septa, up to 8  $\mu$ m diam., lumen visible.

**Habitat:** Calcareous soil in moss, near *Pinus* sp. and *Quercus* sp. solitary, Nov., 1998.

**Distribution:** India; Turkey: Tokat, SES 1001.

**Discussion:** This is similar to *T. pluriosteum* Long & Ahmad, but differs somewhat in the aspect of the spores under SEM. This is a critical species from N. India, and the present identification should be taken with caution. The name refers to specimens having several mouths.

*Tulostoma wightii* Berk., London Jour. Bot. 1: 157, 1842 .

**Macroscopic features:** Spore sac up to 14 mm diam. (Fig. 5 a). Exoperidium thinly membranous. Endoperidium light reddish brown. Mouth apparently fimbriate. Stem (broken) 38x4 mm, with 3-4 longitudinal furrows, otherwise smooth but decorticating, concolorous.

**Microscopic features:** Spores globose to ellipsoid, light yellowish, spiny, 4-6  $\mu$ m under LM; under SEM they appear as having blunt, rather large verrucae, many coalescing to form tablets (Fig. 5b), on the whole the

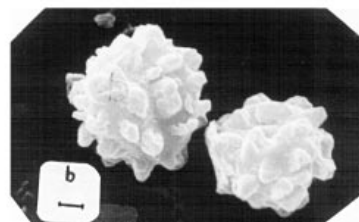


Figure 4. *Tulostoma pluriosteum*: a. Fruit bodies: Bar: 5 mm, b. Photomicrographs of spores under SEM, Bar: 1  $\mu$ m.

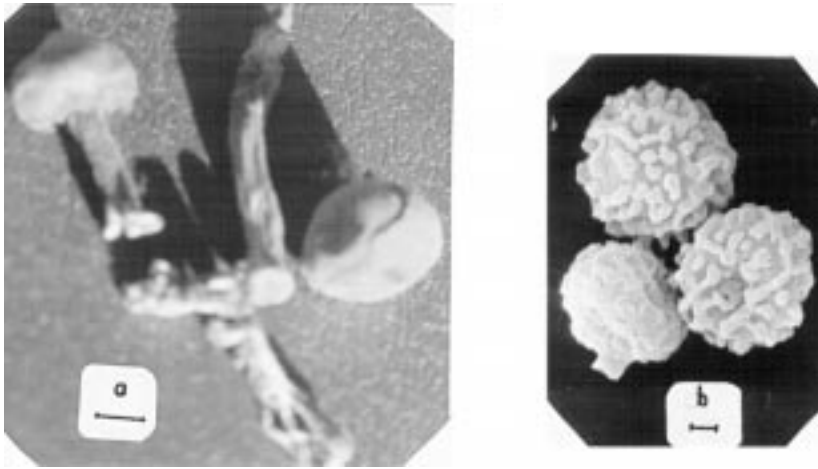


Figure 5. *Tulostoma wightii*: a. Fruitbodies: Bar: 5 mm. b. Photomicrographs of spores under SEM, Bar: 1 µm.

ornamentation being much appressed. Capillitium 5-7 µm diam., sparingly septate, branched, septa not widened, ends dislodged, lumen visible, walls thick, up to 3 µm wide

**Habitat:** In grass, sandy soil, Oct., 1998.

**Distribution:** India; Turkey: Tokat SES 1003.

**Discussion:** This species is known only from the holotype and is therefore critical. The original SEM

photos of the holotype show poor spore material, the ornamentation scarcely discernible. We are keeping the above material under this name since we cannot find another to match it. The original material was described from Madras (India), but we do not know under what ecological conditions.

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